Advanced Geophysical Classification Implementation

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Objective

- Briefly discuss the Advanced Geophysical Classification (AGC) technology to identify munitions
- Review the current instrument status
- Discuss the roles of the seeds used to verify and validate instrument performance
- Explain the role QA and QC have in dynamic and cued data review
- Present the CSM and the vertical component of the CSM

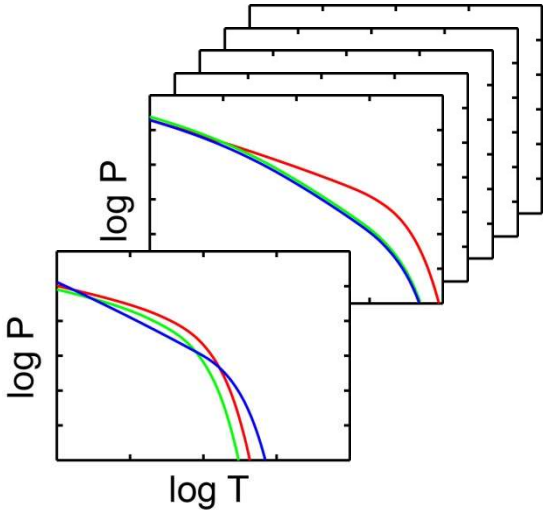
WWII-era 81-mm mortar, Photo courtesy of US Navy.

Classification Applied to Munitions Response

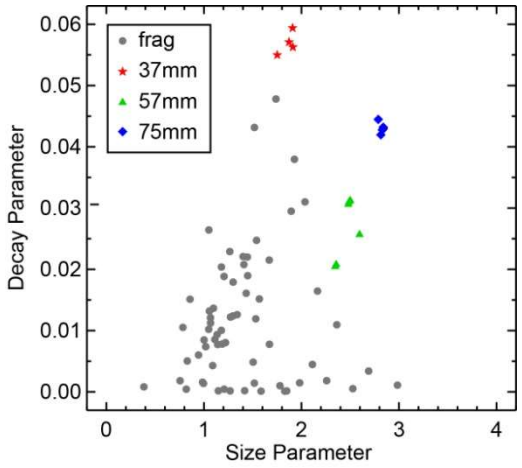
- **Sort buried metal into two classes**
- **Because we cannot see buried objects, we must rely on attributes determined from geophysical data**

Stages in the Classification Process

1. Measure target responses with suitable sensor
   - Classification-specific EMI



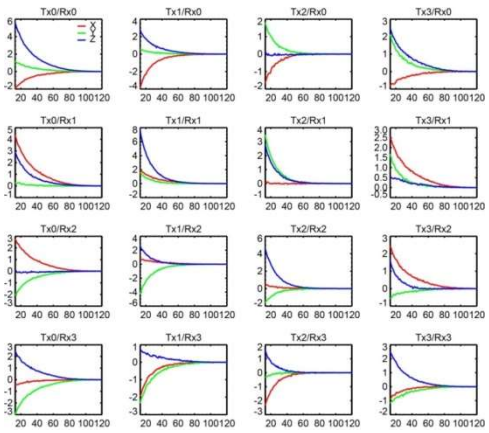
2. Extract target features from the measured responses
   - Data Inversion
   - Target polarizabilities



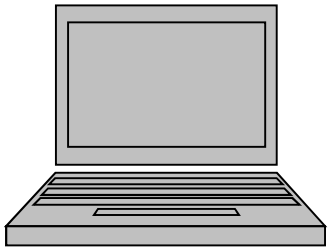
3. Classify targets based on the features
   - Statistical classifiers
   - Library matching

Parameter Extraction (Geophysical Inversion)

Calculate magnetic polarizability (β) using EMI response model for a single source or multiple sources



Sensor Data

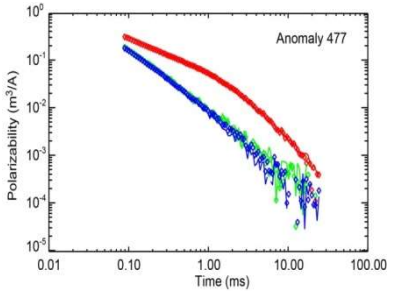


$$V(t) = \mu_0 n_R n_T I_0 C_R \bullet C_T P(t)$$

EMI Response Model (Dipole Model)

Extrinsic Properties

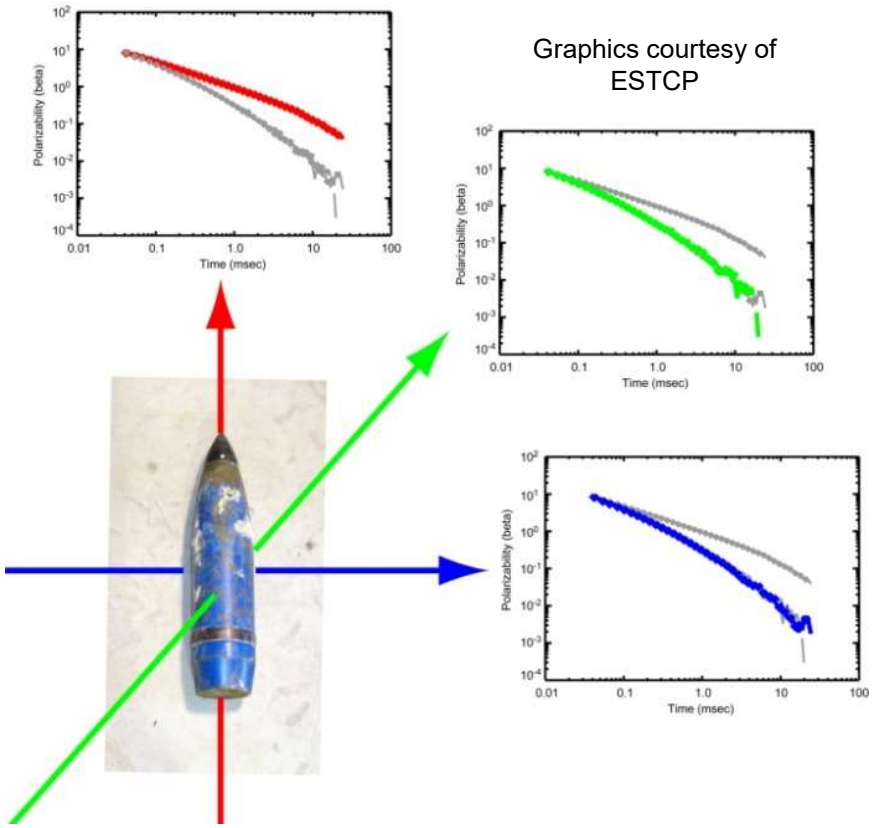
location & orientation



Intrinsic Response

Principal Axis Responses

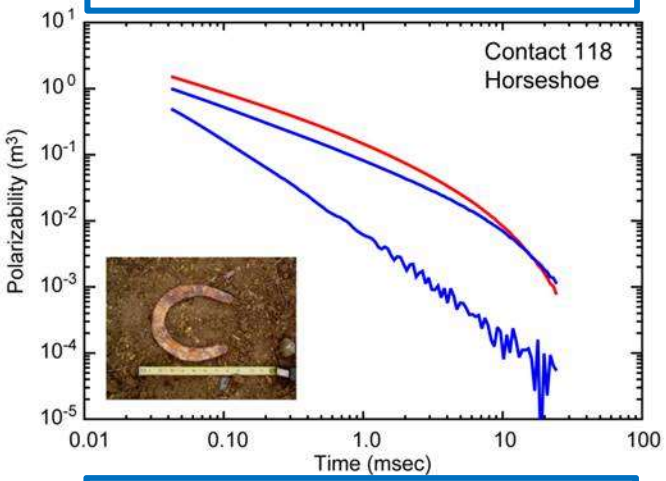
- **Normalized response (polarizability) for excitation in object's principal axis directions are the fundamental EMI attributes**
- **UXO items are symmetrical, so two of the principal axis responses are the same**
- **Irregular clutter items have three different principal axis responses**



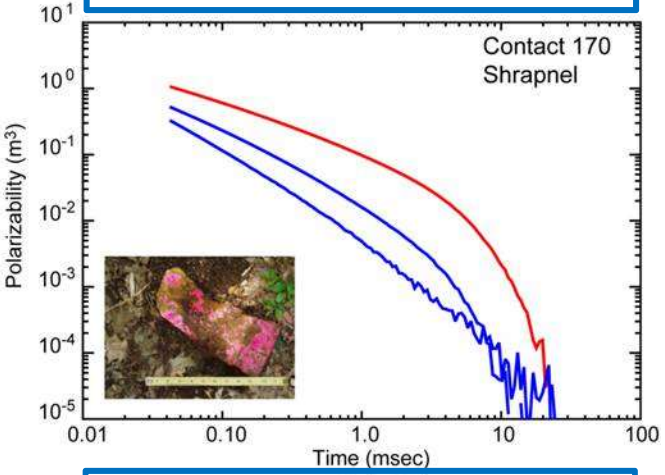
Graphics courtesy of ESTCP

Polarizability Examples "EMI Fingerprints"

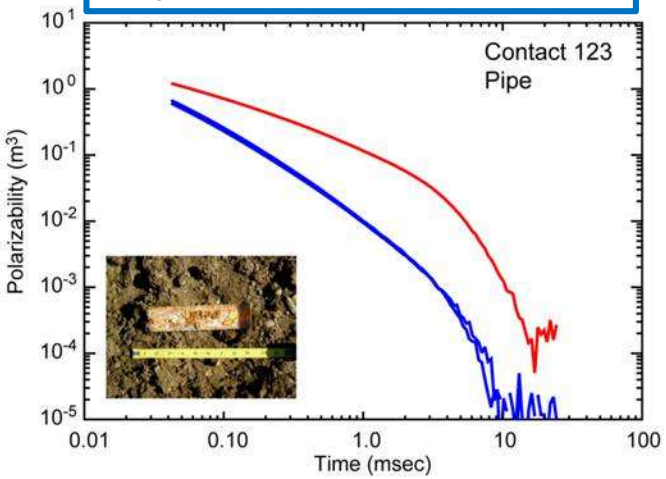
Known Clutter Item



No Symmetry



Symmetric, Thick-Walled



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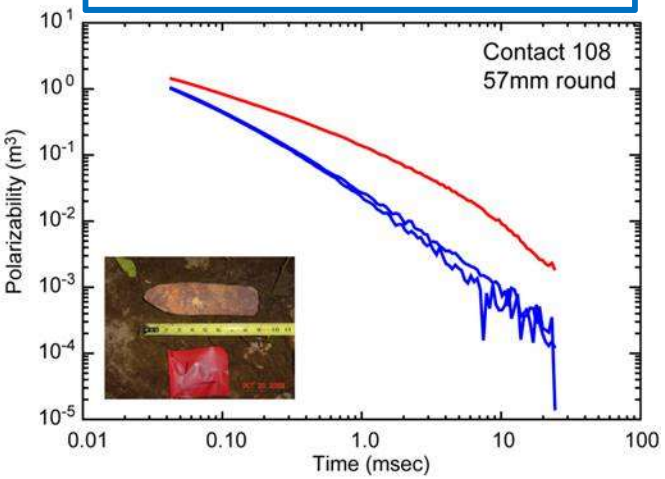
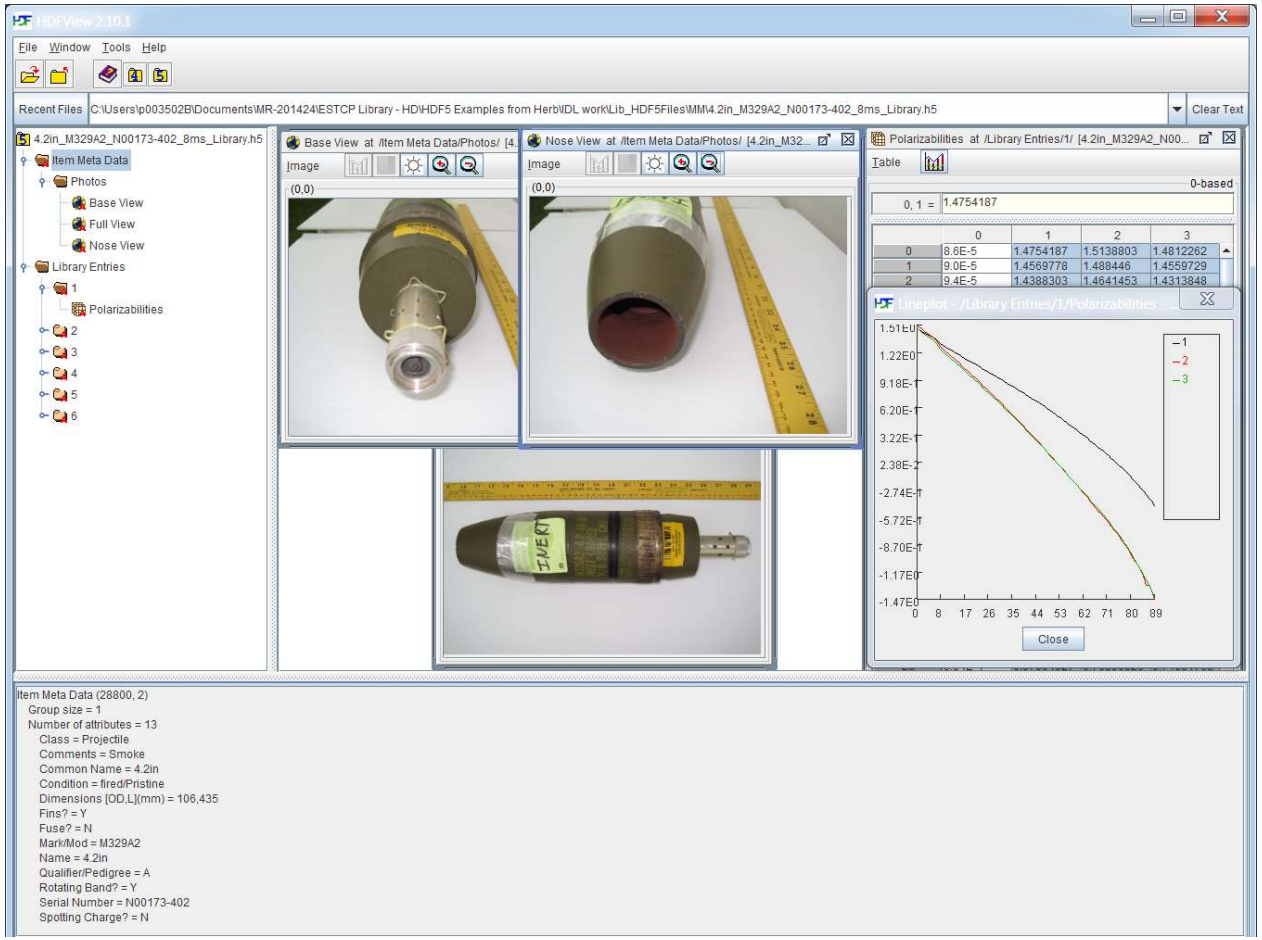


Graphics courtesy of ESTCP

Target of Interest (TOI) Library Match



Collection of TOI signatures:

1. **metadata,**
2. **sensor data, and**
3. **polarizations**

Originally ESTCP generated
DoD maintained

MetalMapper 2X2 and MPV

- 3 2x2 sold so far
- Working with NRL to solve some issues
- Instrument software doesn't do field inversion for cued survey mode
- Equipment overheats in dynamic mode
- EM equipment/Hardware is almost functional as of 2/18
- TEMTADS 2X2 NRL Rental Service to be phased out
- MPVs are available for sale but software needs to be modified for import into Oasis Montaj

Photos courtesy of ESTCP

The Quality Brothers

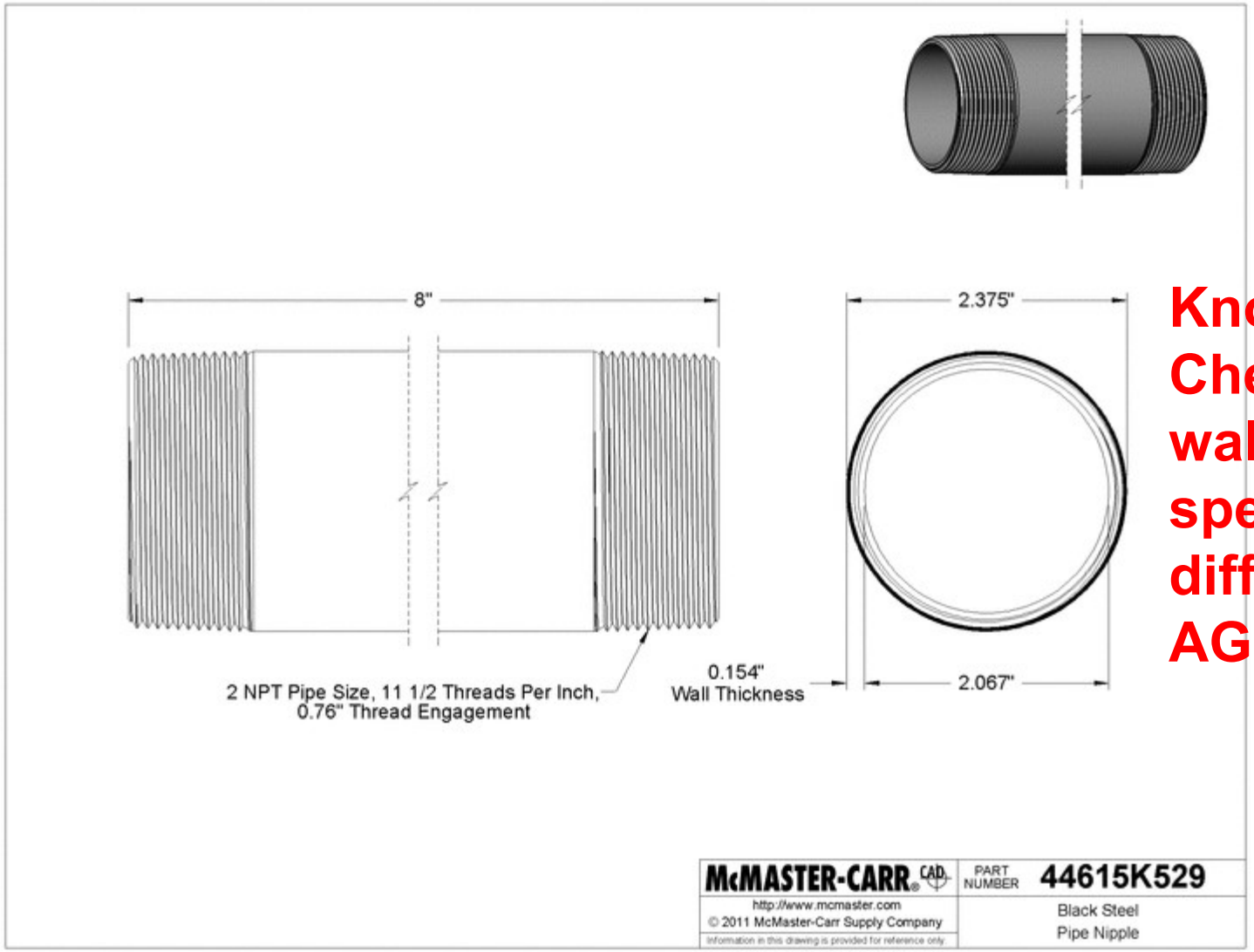
QC Seed

Sometimes known as a verification seed

QA Seed

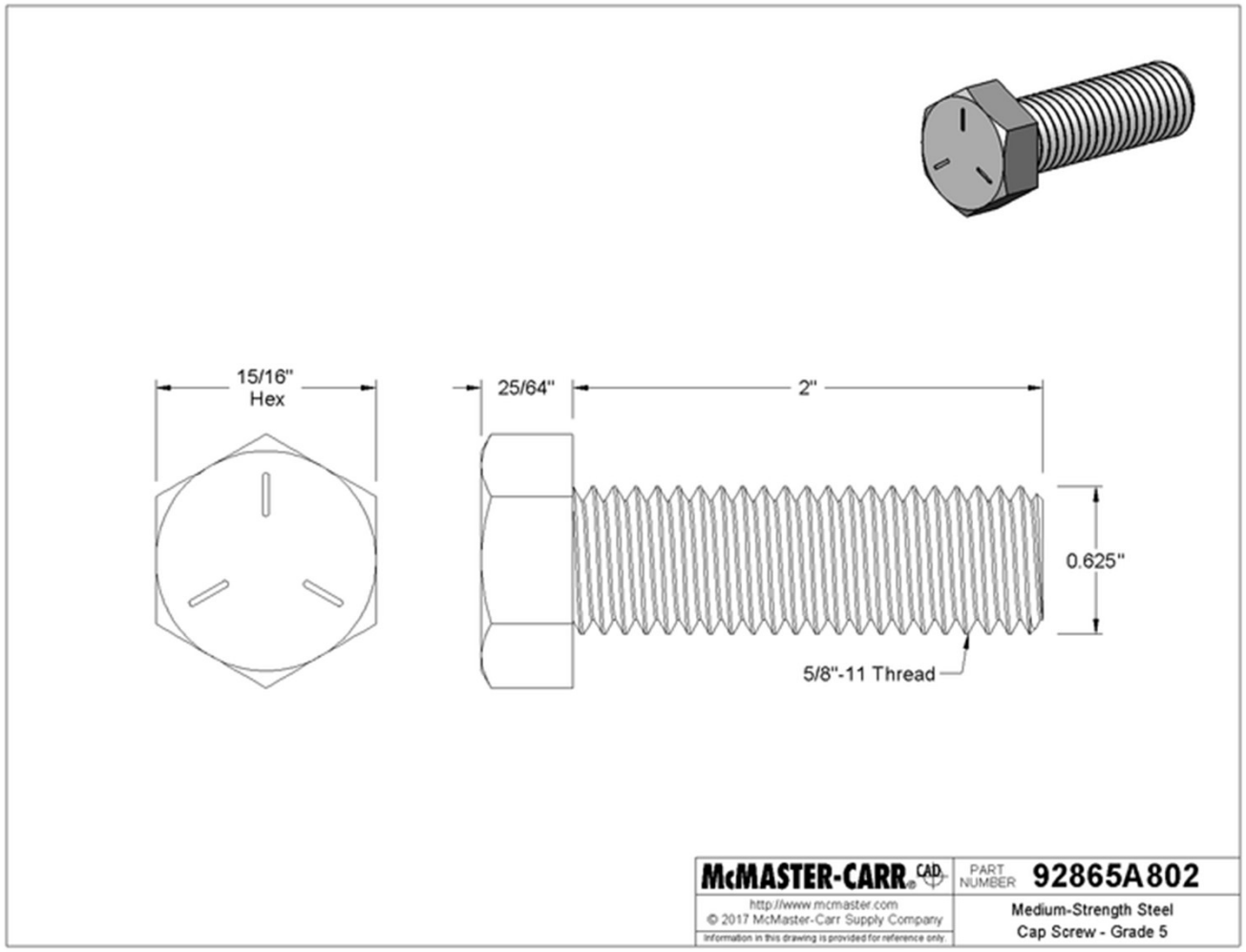
Sometimes known as a validation seed

Same Part Number Medium ISO



Knowledge Check - What wall thickness is specified for the different ISOs for AGC?

The Littlest Brother 20mm Surrogate



Knowledge Check - Is there more than one part number for the 20mm surrogate for AGC?

Roles of the Two Seeds

- QC.
  - Test the performance of the system
  - Should be emplaced horizontally to verify clearance depth
  - Placed at 11X diameter of munition (or expected depth of detection)
  - OK to miss, find flaws and fix them
  - QC seed plan needs to be specific about emplacement and blind to production crews
- QA.
  - Test the Contractors process
  - Should be placed horizontally to validate the process
  - Placed at 4 to 7X diameter of munition
  - Not ok to miss, must be reported, potential loss of accreditation

Seed Emplacement

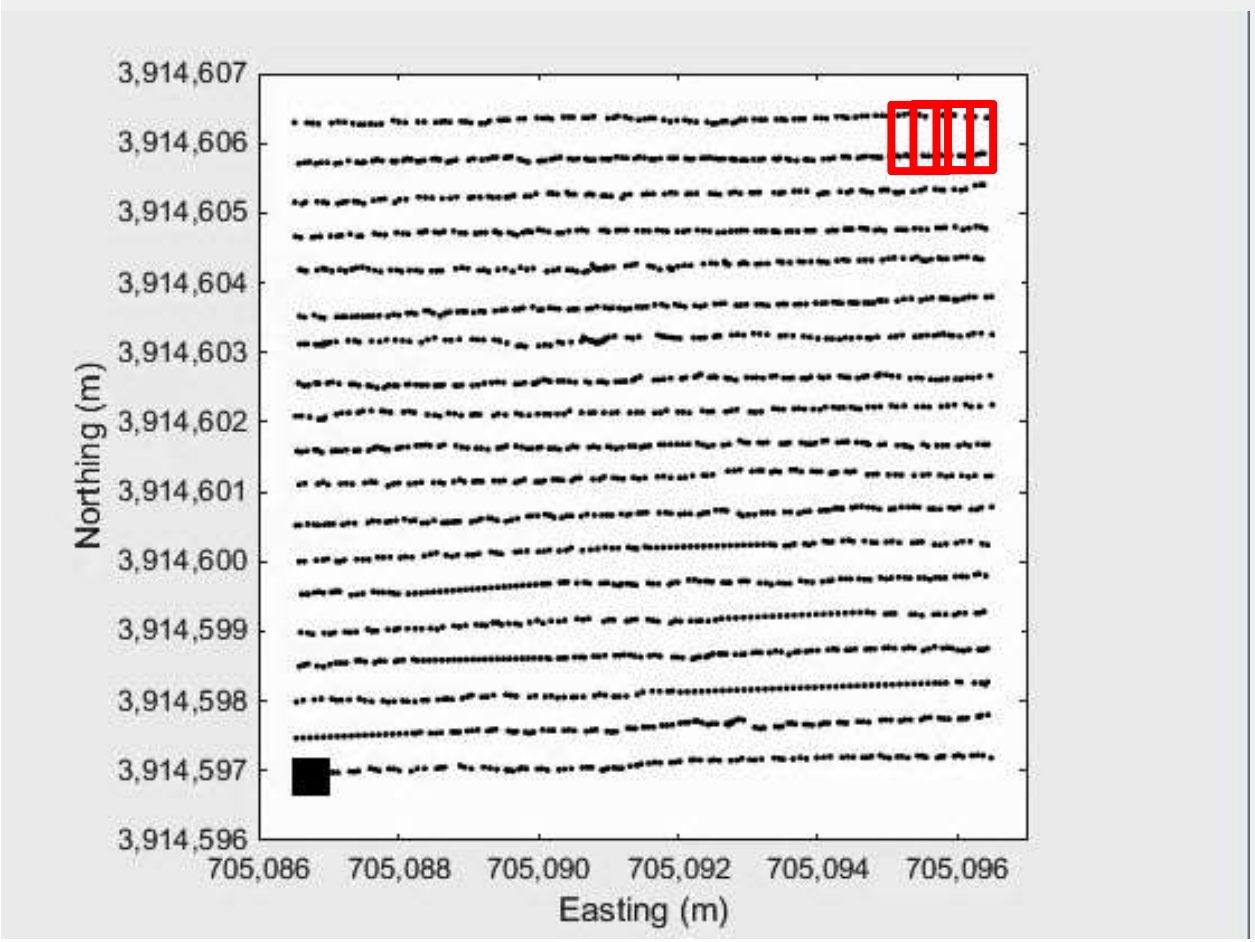
- **Both QC and QA Require High Quality Emplacement.**
  - **Important measure of accuracy**
  - **Survey level emplacement accuracy (1 inch geometric center) for x, y, and z position by licensed surveyor**
  - **Common mistake to emplace at wrong depth (QAPP specifies cm and field crew installs at inches)**

Seed Emplacement

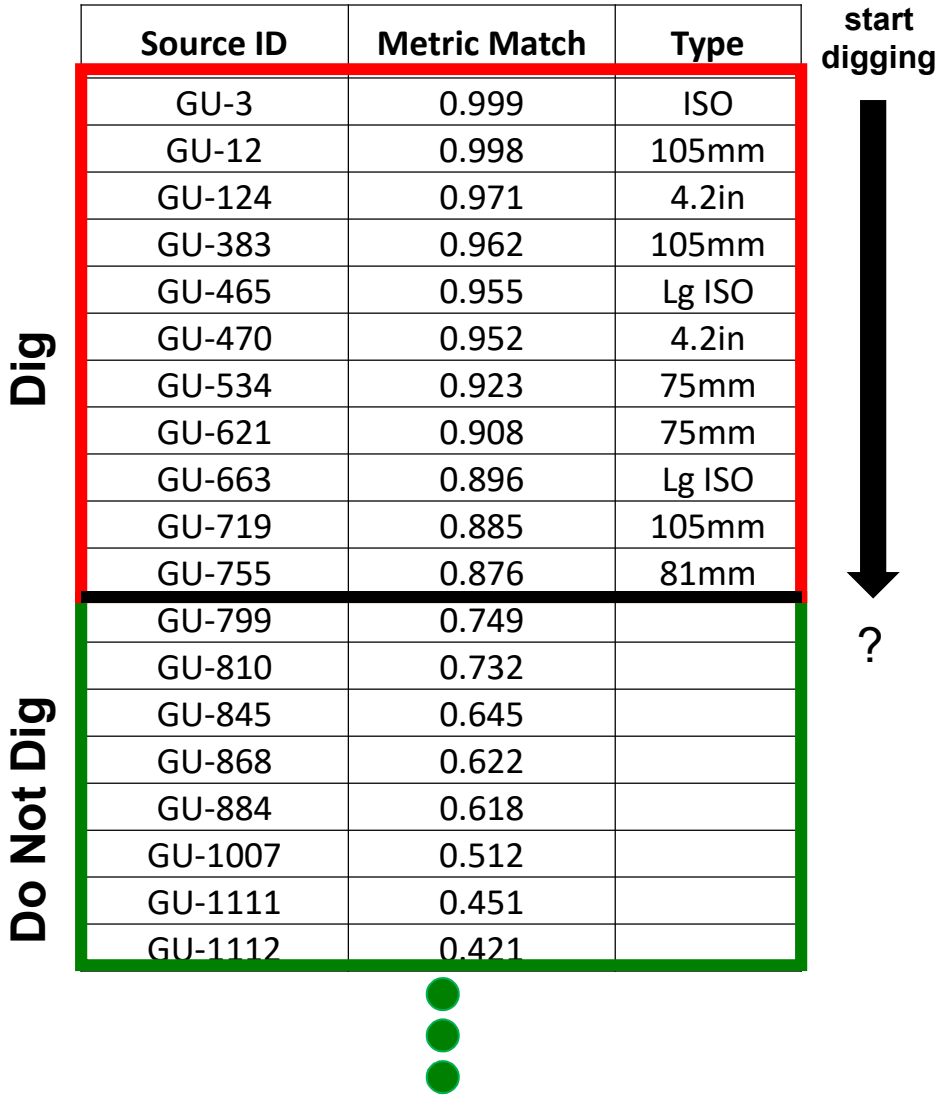
Photo courtesy of ESTCP

Data Review Dynamic and Cued (1)

- Contractor responsibility to provide an accurate product for dynamic and cued data
- Third party must review as well both the dynamic and cued data



Data Review Dynamic and Cued (2)



Accreditation

DoD Policy Requires AGC contractors to be accredited

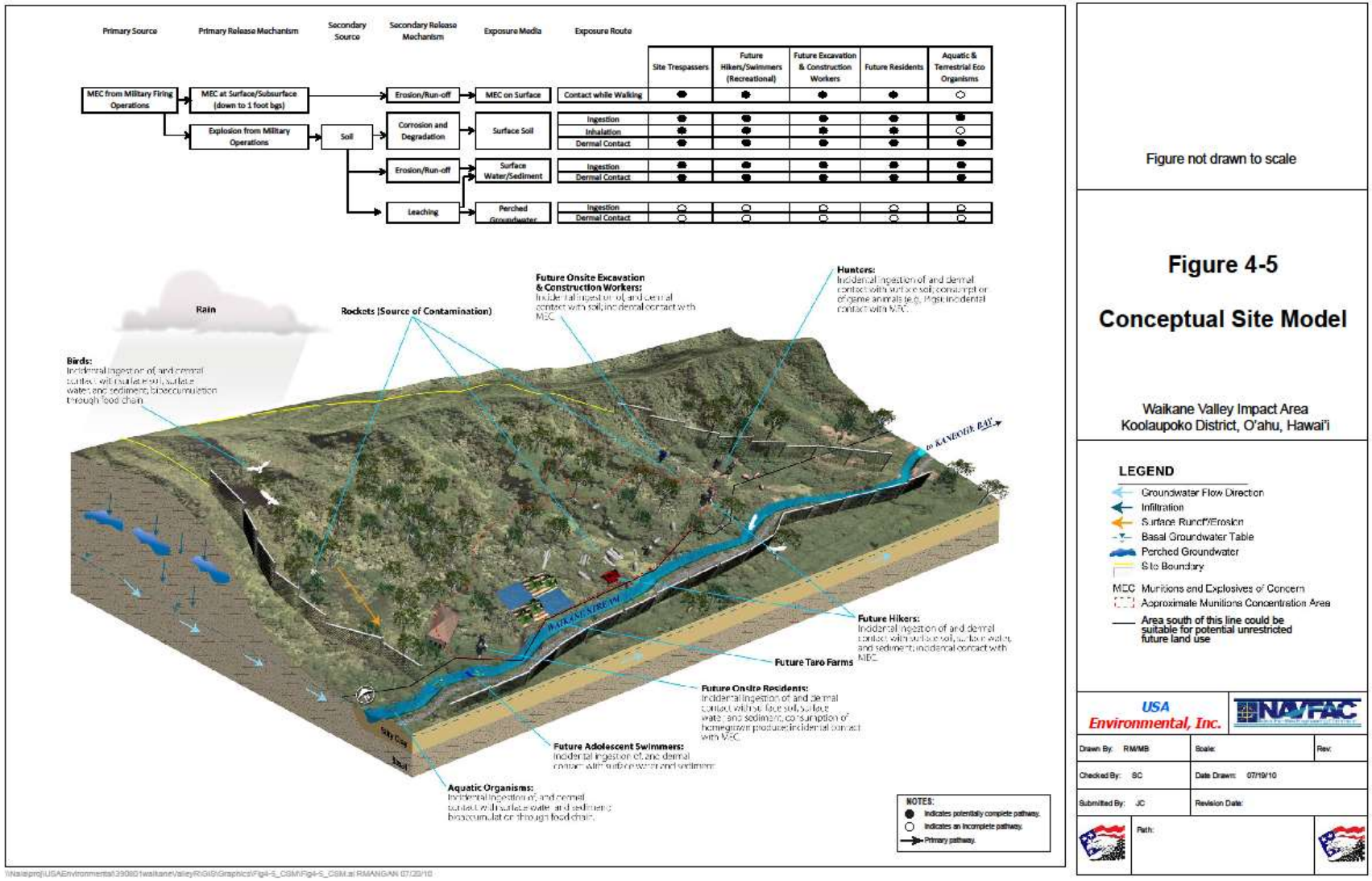
- **9 companies are now accredited**
  - **Passed Quality Systems Documentation**
  - **Passed APG field test of data analysis**
- **Accredited companies are**

Parsons
CH2MHill, now Jacobs
TetraTech
TPMC White River
APTIM

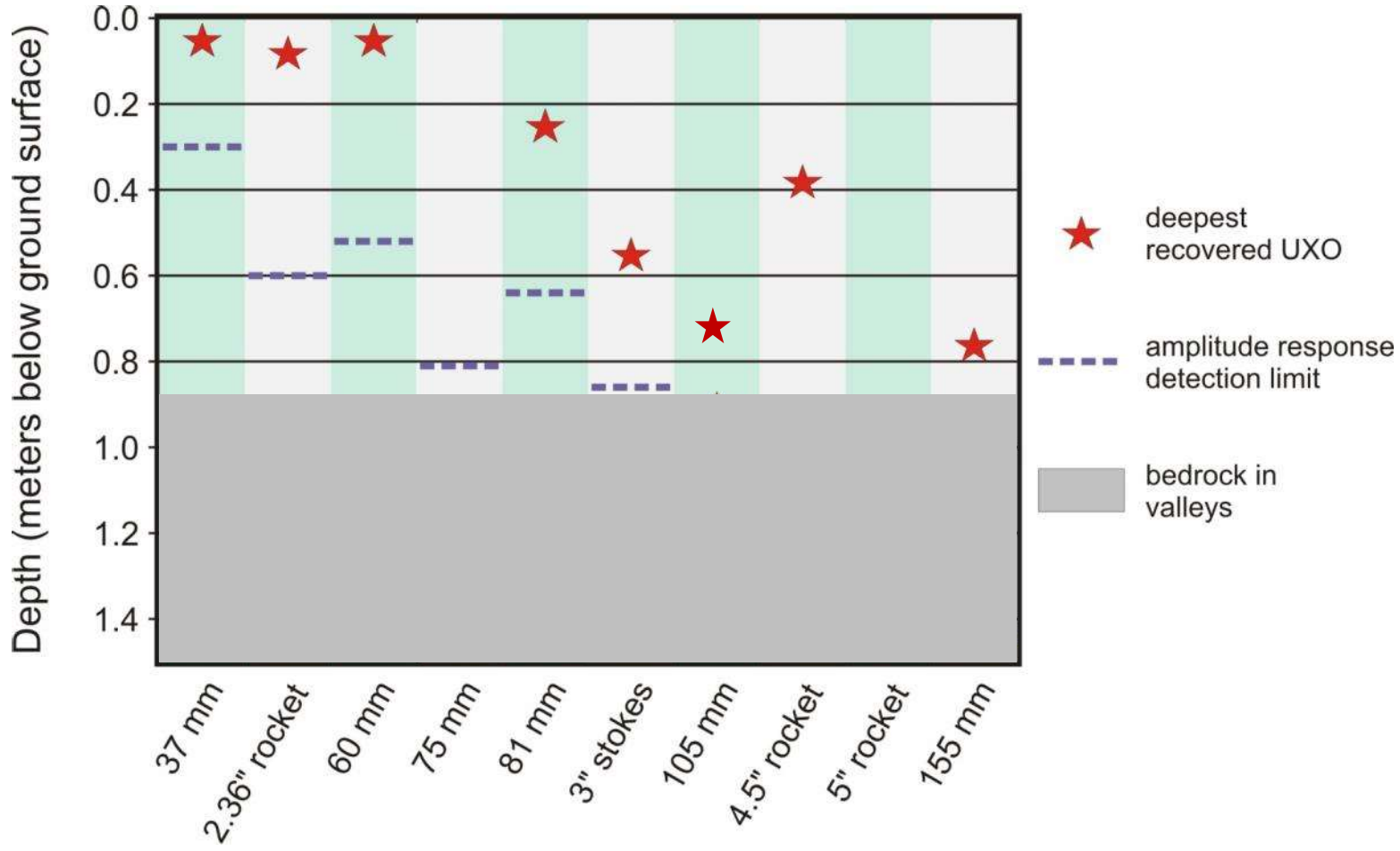
AcornSI/Naeva
Black Tusk Geophysics
Arcadis
Weston

- **Several more companies applying for review and APG test this year**
- **Not all companies have passed the test**
- **For Navy third party QA, not required to be accredited, but it sure would be a good thing. (e.g. What happens when it turns into a he said/she said type of dispute)**

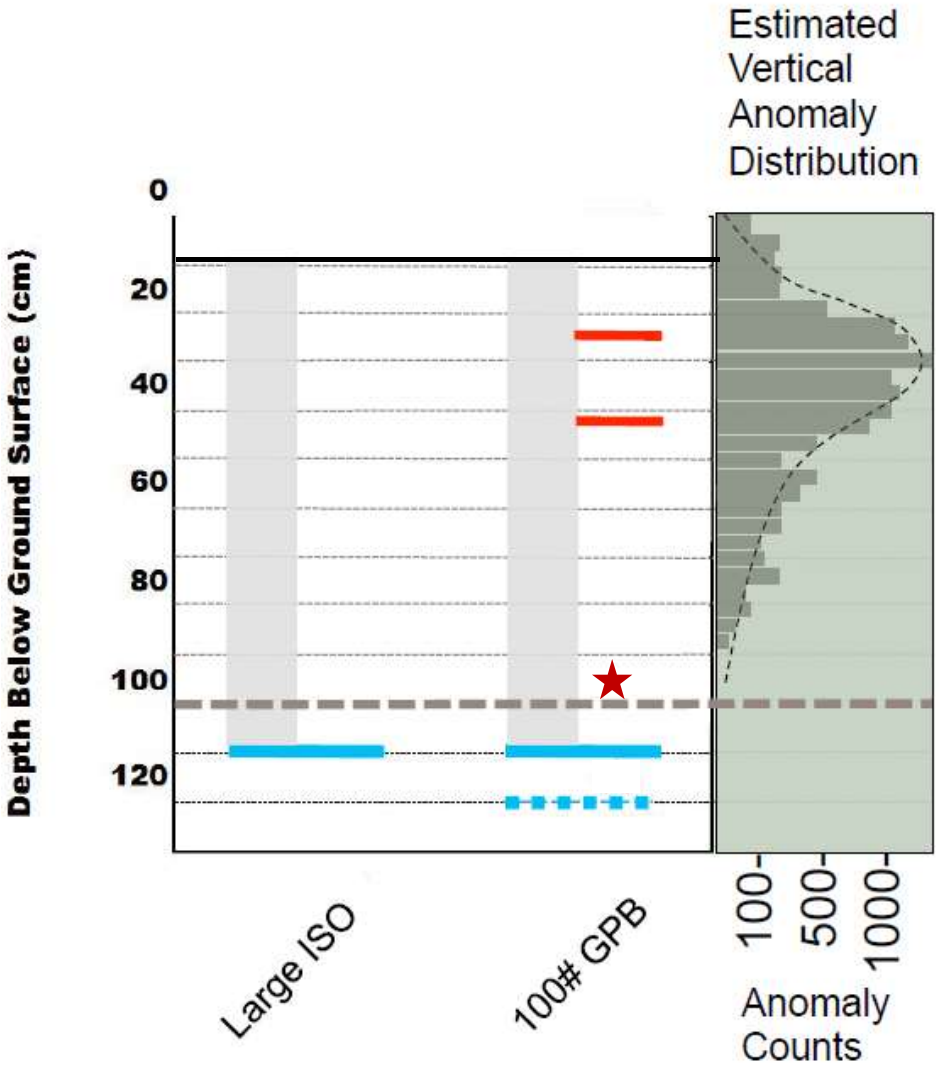
Traditional CSM w/Horizontal Extent

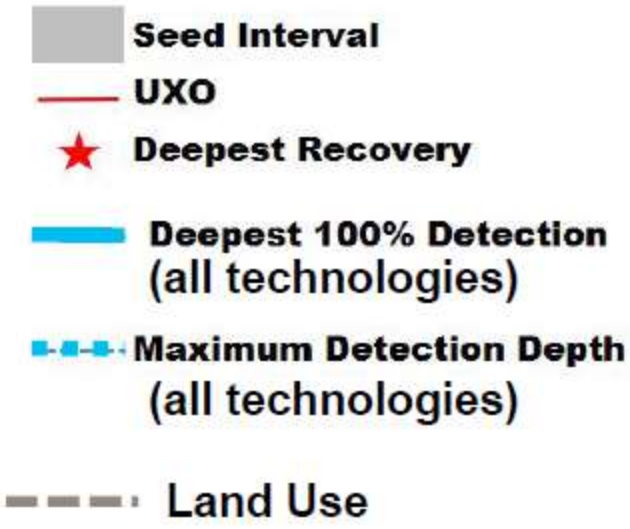


Basic CSM – Vertical Distribution of MEC



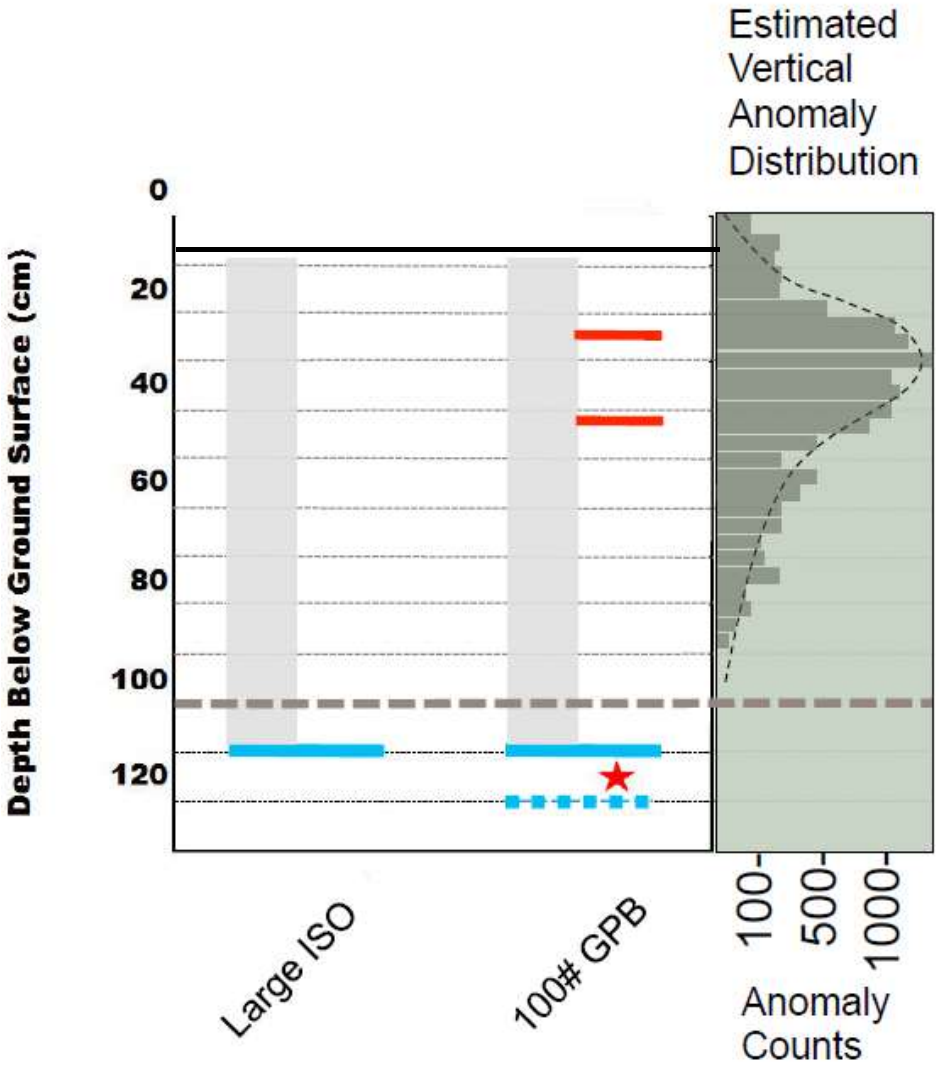
CSM – Vertical Distribution of MEC w/Data

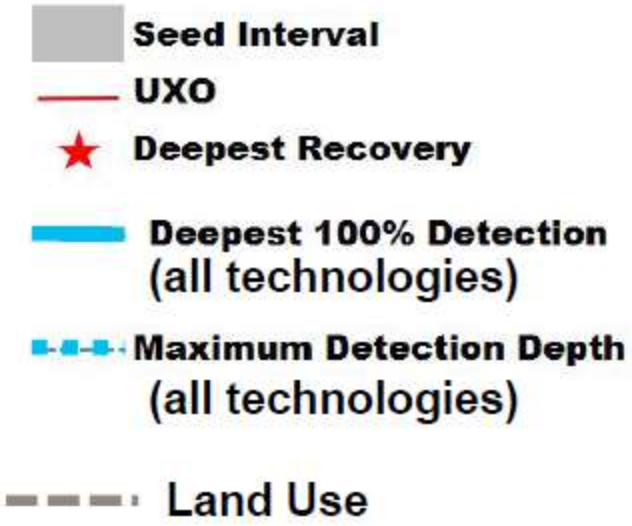




Knowledge Check - What type of remedy could this CSM support?

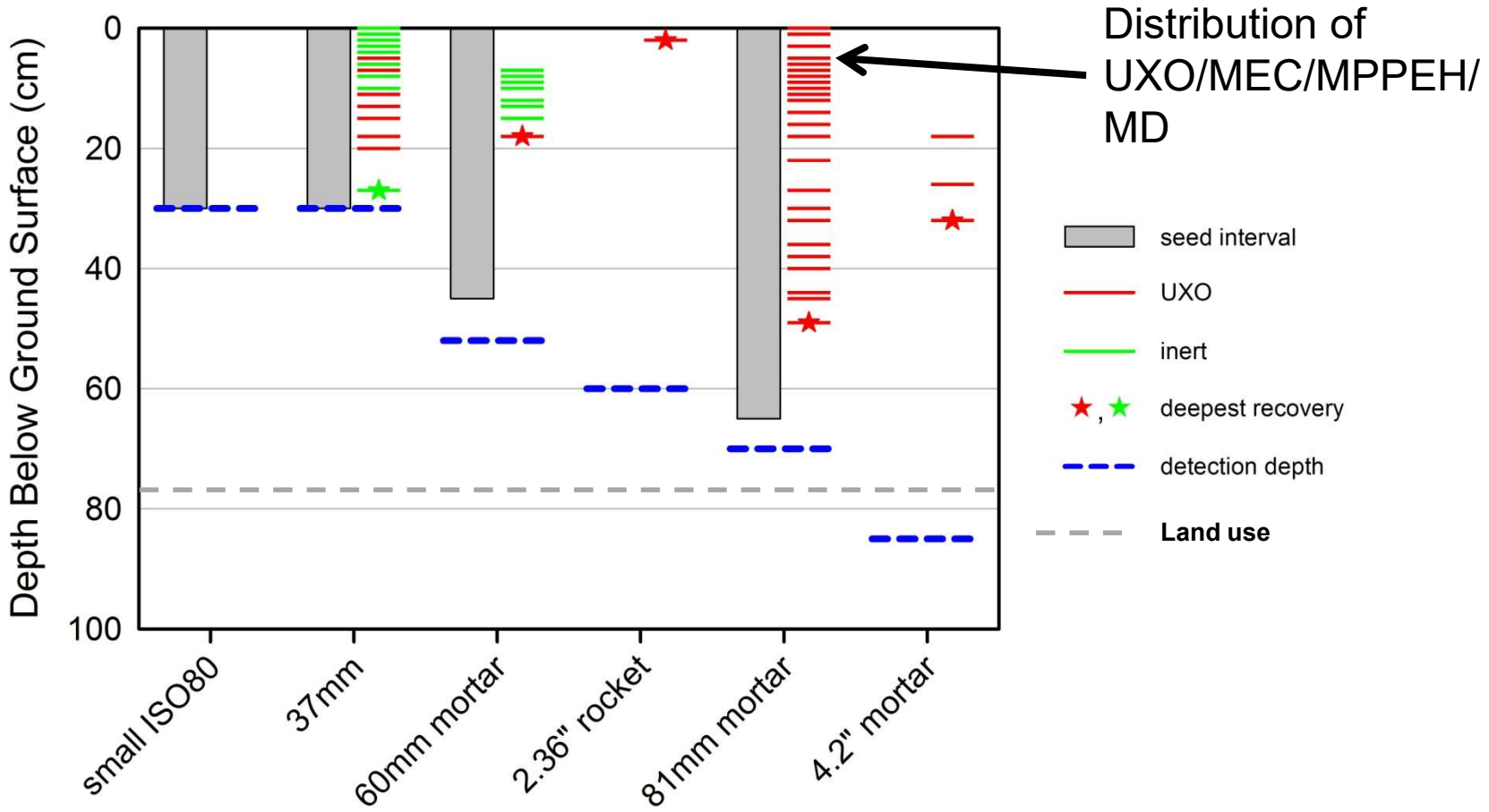
CSM – Vertical Distribution of MEC w/Data



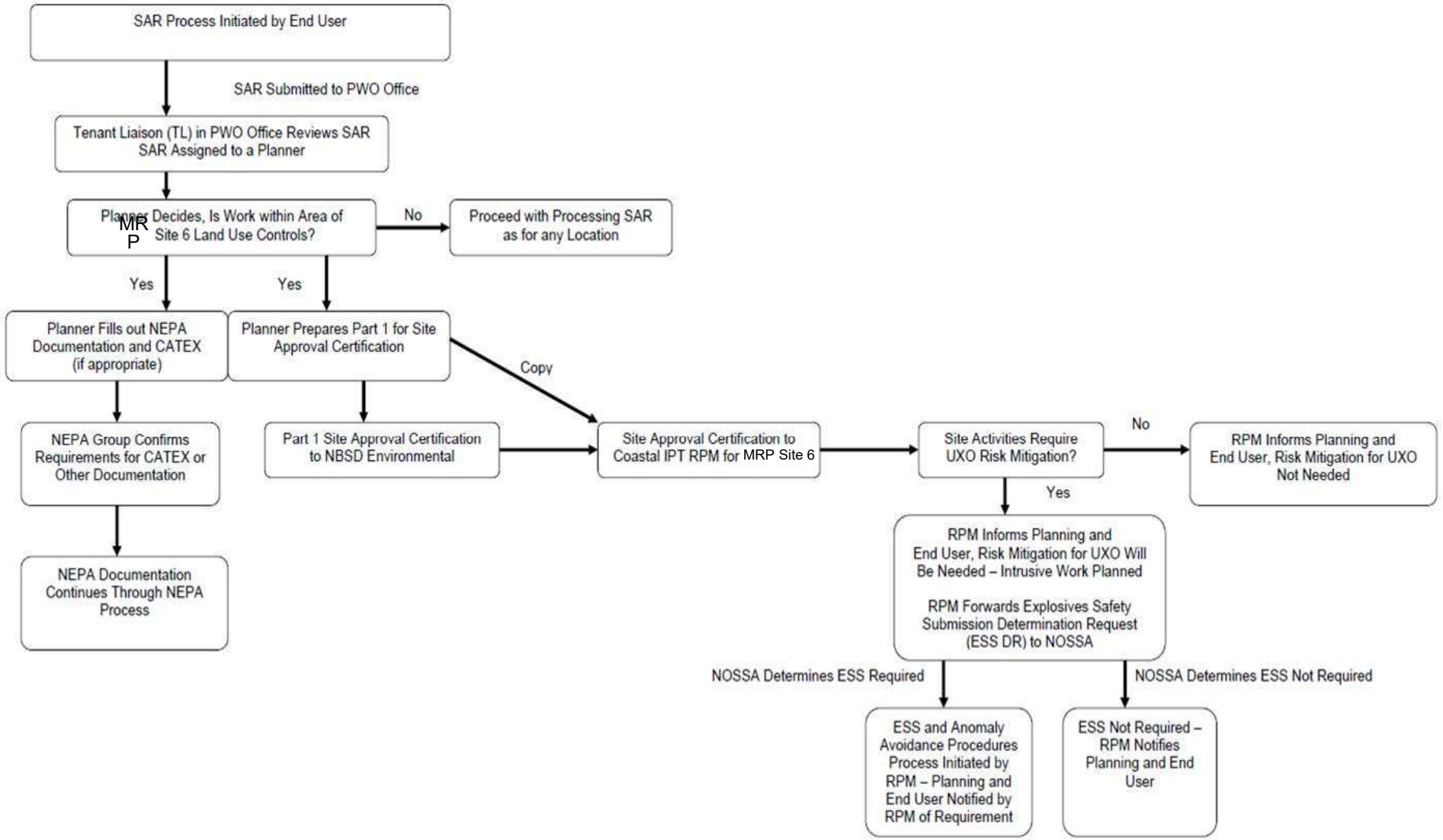


Knowledge Check - What type of remedy could this CSM support?

After Action Vertical CSM



Installation Master Plan/Regional Integrated Master Programs
Construction Site Approval Request



ITRC Quality Considerations

- New document produced by Interstate Technology and Regulatory Council on Quality Considerations for Munitions Response
- Discusses the concepts and application of quality control and assurance on MR projects.
- A significant portion of the document is on AGC quality considerations
- Case Study on the application of AGC

Summary

- More useful instruments available
- Checks on quality rely heavily on seeding
- Contractors and Third Party QA must perform Data Review
- Accredited contractors are available
- The vertical CSM is important

Contacts and Questions

Points of Contact
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NAVFAC LANT: Tim Wenk – tim.wenk@navy.mil
Questions ?

Supplemental Information

Helpful Resources

- **SERDP –ESTCP Munitions Response Website**
  - **www.serdp-estcp.org**
- **NAVFAC Munitions Response Reference DVD**
  - **NAVFAC RI/FS Guidance**
- **Interstate Technology and Regulatory Council**
  - **Geophysical Classification document**
  - **Quality Considerations for Munitions Response**
- **DENIX Website**
  - **Current list of accredited contractors**
  - **www.denix.osd.mil**